NASA Center for Climate Simulation Success Story

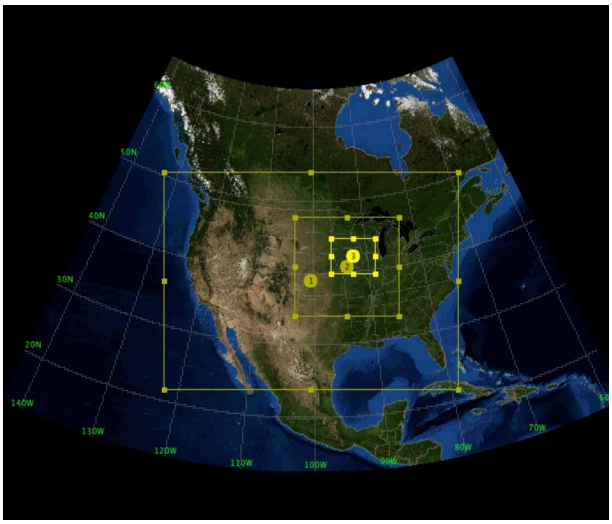
Modeling in the Field for GPM

December 15, 2014

In expeditions ranging from Arctic sea ice to Caribbean hurricanes, a host of NASA field campaigns have relied upon the NASA Center for Climate Simulation (NCCS) for real-time weather forecasts and data services. NCCS recently partnered with NASA Goddard Space Flight Center modelers to support ground- and aircraft-based campaigns for the Global Precipitation Measurement (GPM) satellite mission in two distinct regions of the United States.

GPM is a joint mission of NASA and the Japan Aerospace Exploration Agency designed for improving the accuracy, coverage, and dynamic range of precipitation measurement. Since it launched on February 27, 2014, the GPM Core Observatory has shown that its instruments can measure not only the location and intensity of precipitation but also observe transitions between precipitation types (e.g., rain to snow) from space for the first time.

Satellites like GPM need field campaigns to maximize data accuracy. For new instruments, ground-based measurements help calibrate data taken from a different perspective atop the atmosphere. As part of validation, campaign aircraft carry similar instruments so scientists can compare observations of the same locations.



The NASA-Unified Weather Research and Forecasting (NU-WRF) model configuration for the Iowa Flood Studies (IFloodS) field campaign included three nested grids with increasing resolutions: ❶ 9 kilometers (km) for the entire U.S., ❷ 3 km for a portion of the Midwest, and ❸ 1 km for the state of Iowa.

Reliable weather forecasts are key to campaign success. “From a planning point of view, field scientists want to see what the weather will be each day,” said Di Wu, research scientist in NASA Goddard’s Mesoscale Atmospheric Processes Laboratory. “It is crucial for their decision-making.”

Wu is part of a team developing and running the NASA-Unified Weather Research and Forecasting (NU-WRF) model, an enhanced version of the widely used WRF model. NASA add-ons include components for land surface modeling, atmospheric and land data assimilation, aerosols, and cloud microphysics.

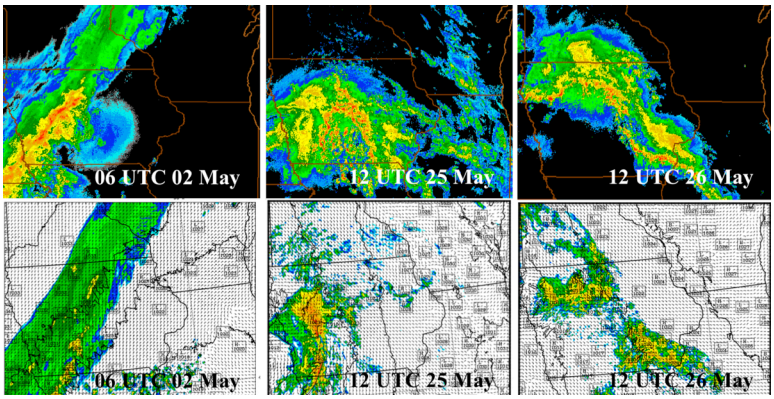
The NU-WRF team joined others in providing daily forecasts for Iowa Flood Studies (IFloodS), held May 1–June 15, 2013, and the Integrated Precipitation and Hydrology Experiment (IPHEx), held May 1–June 15, 2014. IFloodS focused on Iowa and the nearby Midwest (see image above), while IPHEx encompassed Appalachian Mountain river basins in North Carolina, South Carolina, and Tennessee.

Using 2,048 processor-cores on the NCCS Discover supercomputer enabled running NU-WRF in interacting nested grids of 9-, 3-, and 1-kilometer resolution. Such fine resolution improves representation of clouds and the precipitation they produce. Assimilating observed precipitation and soil moisture data supplied initial conditions for 2-day forecasts, which ran twice per day for IFloodS and once per day for IPHEx. NU-WRF forecasted fields including precipitation, total precipitable water, CAPE (an indicator of possible convection), and radar reflectivity on an hourly basis. “One hour is essential especially if there is an aircraft deployment that day,” Wu said.

NU-WRF forecast images were continuously available through a tailored web interface to the NCCS Data Portal. During IFloodS, NU-WRF principal investigator Christa Peters-Lidard said she “received very positive feedback about NU-WRF performance, and the images were used extensively in the daily forecast discussions. The timely delivery of these forecast products has had a significant and beneficial impact on campaign operations and planning.”

Wu noted that field scientists were also pleased with NU-WRF forecasts giving very accurate locations, which are vital to determining if there is flooding in particular water basins.

Supporting broader IPHEx objectives, NU-WRF and other U.S. modeling groups continue assessing their forecasts as well as sharing model output. In turn, the NU-WRF team is benefitting from the collected IFloodS and IPHEx datasets by using them to validate and ultimately improve the model.



Three major May 2013 precipitation events as viewed by Next-Generation Radar (top) and forecast by the NU-WRF model (below) for IFloodS.

Jarrett Cohen
NASA Goddard Space Flight Center

Contacts

Di Wu
Research Associate
Mesoscale Atmospheric Processes Laboratory
NASA Goddard Space Flight Center/SSAI
di.wu@nasa.gov
301.614.5703

Wei-Kuo Tao
Senior Research Scientist
Mesoscale Atmospheric Processes Laboratory
NASA Goddard Space Flight Center
wei-kuo.tao-1@nasa.gov
301.614.6269

Christa Peters-Lidard
Physical Scientist
Hydrological Sciences Laboratory
NASA Goddard Space Flight Center
christa.d.peters-lidard@nasa.gov
301.614.5811

Dan Duffy
High-Performance Computing Lead
NASA Center for Climate Simulation
NASA Goddard Space Flight Center
daniel.q.duffy@nasa.gov
301.286.8830

More Information

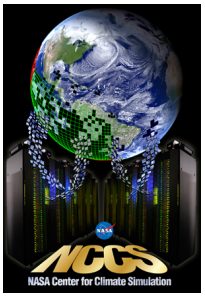
Integrated Precipitation and Hydrology Experiment
http://pmm.nasa.gov/IPHEx

Iowa Flood Studies
http://pmm.nasa.gov/IFloodS

NASA-Unified Weather Research and Forecasting
http://nuwrf.gsfc.nasa.gov

Research Paper

Tao, W.-K., D. Wu, T. Matsui, C. Peters-Lidard, S. Lang, A. Hou, and M. Rienecker (2013), "The Diurnal Variation of Precipitation During MC3E: A Numerical Study," *Journal of Geophysical Research: Atmospheres*, 118, 7199–7218.
http://onlinelibrary.wiley.com/enhanced/doi/10.1002/jgrd.50410/abstract



NASA Center for Climate Simulation
High-Performance Science
http://www.nccs.nasa.gov